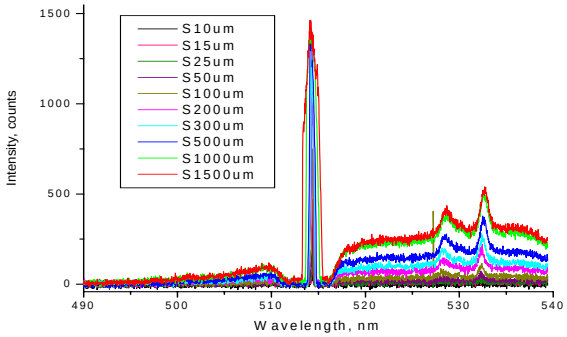
Home Work 1: Phys774 Principles of Spectroscopy

***Spectrometer Bandpass* dependence on the *Entrance Slit Width* and basic spectrum analysis (peak separation).**

1. Plot experimental dependence of the FWHM for the laser line at 514 nm as a function of the slit width. (Use spectral range from 513 to 516 nm).
2. Use linear fit approximation and determine Bandpass /slit width coefficient *K*. Present your answer in the units of [nm/μm].
3. Report major contributions into the bandpass value for the spectrum t180sec150um.dat measured with the slit width of 150 μm:
   a. $\Delta\lambda_{slit}$ =
   b. $\Delta\lambda_{grating}$ =
   c. $\Delta\lambda_{natural}$ =
   d. Bandpass = $\sqrt{\lambda^2_{slit} + \lambda^2_{grating} + \lambda^2_{natural}}$
4. Determine position, FWHM, and intensity for 4 peaks in the measured spectrum t180s150um.dat in the wavelength range of 526 to 535 nm.
5. Discuss the difference between the bandpass and the FWHM of the four peaks. What is $\Delta\lambda_{natural}$ for the measured peaks?

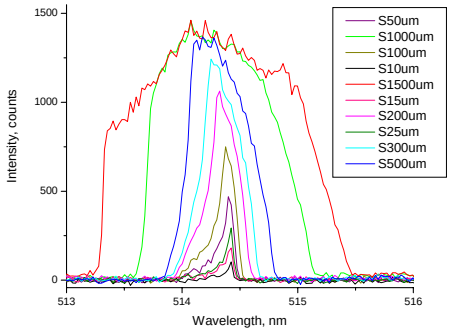
Instructions for the HW1

a. Download ZIP file HW1.zip with experimental spectra measured with 500M spectrometer. The set of date has 11 spectra: S*s**um.dat, where * stays for the accumulation time and ** is the slit width. For example, S10s1000um.dat is the file measured for 10 seconds with the slit width of 1000 μm. First column of the file is the wavelength in nm, the second column is the measured Intensity. The wavelength range is the same for all measured spectra.
b. Use Labview, ORIGIN, or any other program of your choice for data analysis. Labview is free for NJIT students and can be downloaded from NJIT software website.
c. One of the files inside the ZIP is in the ORIGIN format, which already contains all experimental spectra.
d. The set of the experimental files is here. You can see the broadening of the central laser peak.



e. Note that the central peak originates from the Ar-ion laser model 2020. Its wavelength is 514.5… nm. Find out the exact value with 3 significant figures after the decimal point.

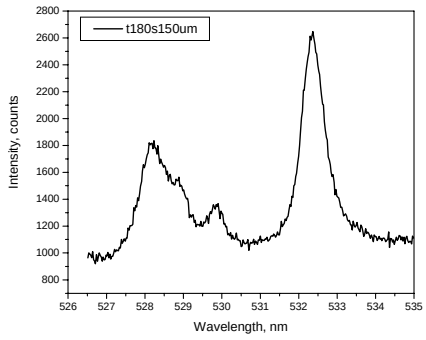
f. To answer question#1 use only the central part of the measured spectra:



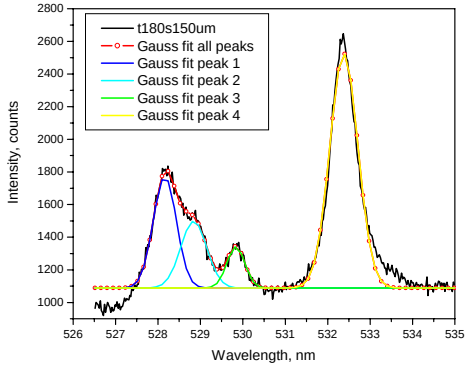
g. To answer question#3, you need to refer to the website of Spectra-Physics (the manufacturer of Ar laser) or the manual of the laser and write down $\Delta\lambda_{natural}$ =

To find $\Delta\lambda_{grating}$ you need to remember that this value is equal to λ/R, where λ is the measured wavelength and R is the resolving power of a grating. For our spectrometer, which is using the first order of diffraction, R=N(total number of groves)=1200gpm*80mm=96000.

h. For the question#4 you need to use t180s150um.dat file. The slit width was 150 μm. Analyze the following part of the spectrum for your fit analysis:



i. You should get something close to that for the Gauss fit.



j. Tabulate your results and include errors. For extra credit you can try to use Lorentz fit and/or the linear background.

	Peak1	Peak2	Peak4	Peak4
Measured Wavelength [nm] Corrected Wavelength [nm]				
Intensity [counts]				
FWHM [nm]				

k. Refer to the literature value for the Ar-ion laser frequency and determine the systematic error of the measurements by comparing this number to the experimental position of the laser line at 514 nm. This will give you an offset of the Wavelength axis.

l. Correct the peak positions in your Table.